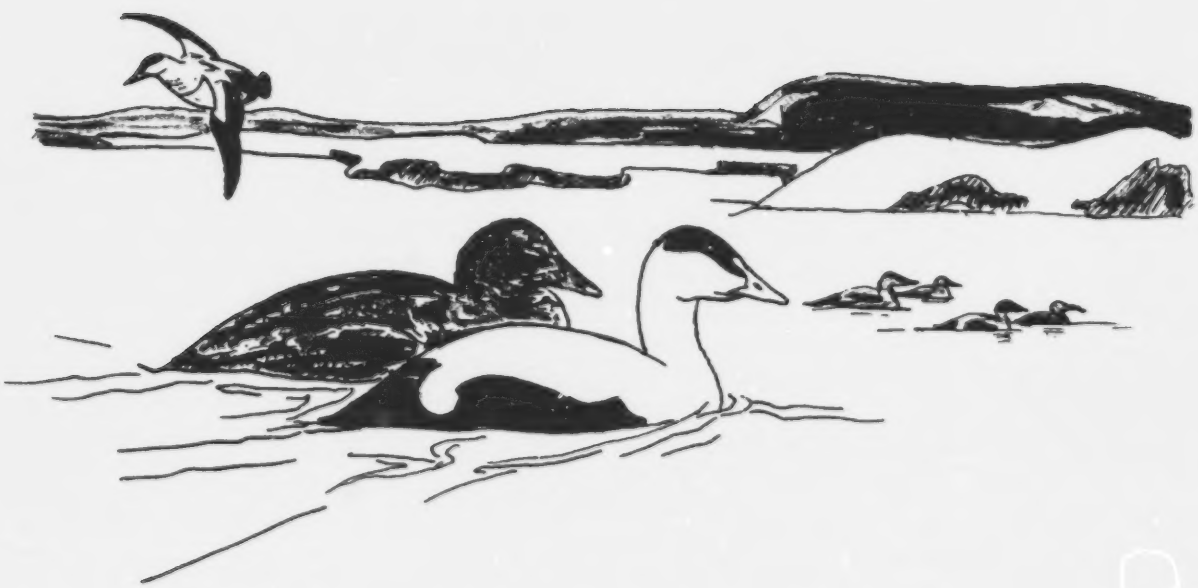
Sea-Bird Surveys in the Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait 1981 Season

by Samuel J. Barry
and Thomas W. Barry



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SEA-BIRD SURVEYS

IN THE BEAUFORT SEA, AMUNDSEN GULF, AND PRINCE OF WALES STRAIT,

1981 SEASON

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and

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ABSTRACT

Nine surveys of sea-birds were flown along the water's edge of the Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait during late May through September 1981 to compare with similar flights in 1980 and to locate the major nesting and brood-rearing areas of common eiders. The Beaufort Sea in 1981 had areas with less open water for spring migrants than in 1980, although Amundsen Gulf was nearly ice-free. Densities of sea-birds in spring migration were higher in the restricted open leads; later, however, the densities of molting sea-ducks were generally lower. Nevertheless, the areas of bird concentration remained the same as the year before. The 1981 surveys allowed important habitat for sea and coastal birds to be evaluated.

INTRODUCTION

The Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait have areas that are important in the life histories of sea-birds. The region is used by sea-birds during migration, nesting, molting, feeding, brood-rearing, etc. These phases in the birds' yearly cycle occur at different places and at different times of the season, varying with each species and with age classes within the species.

In 1980 we conducted surveys of the Beaufort Sea region to estimate densities of sea-birds throughout the open-water season (Barry et al., 1981). The surveys were repeated in 1981 to monitor the sea-birds and to refine our judgment of the more important areas. That is, the places to which we had given a "habitat rating" of 1 or 2, (high in a scale of 1 through 5) were now re-analyzed, using segments of transects falling within the areas in question.

The littoral zone and offshore waters of the Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait is vast, and much of the area is not of prime importance to sea-birds. In our judgment, the nearly continuous ice coverage of Viscount Melville Sound and M'Clure Strait and their unsuitability for marine bird species precluded further monitoring surveys there in 1981. As for the Beaufort Sea and its approaches, we felt it necessary this time to locate and describe the more important areas.

Our objectives for 1981 thus became:

1. to repeat the 1980 surveys, keeping as close as possible to routes and dates both, in order to compare densities of populations, and ice and weather conditions.

2. to define areas of primary importance to sea-birds;

3. to extend the surveys later in the season than in 1980 so as to cover the migrations and staging of eiders with young.

This report, then, is in some respects supplementary to our report on the 1980 season (Barry et al., 1981), and the two should be considered together.

METHODS

The data used in this report were collected on nine aerial surveys flown between early June and late September, 1981. The survey area is shown in Figure 1. All of our surveys were flown at an altitude of 30 meters and within 200 to 300 meters of the ice edge or shoreline. One observer on each side of the aircraft identified and tallied species of birds seen within 200 meters of the flight path. The aircraft used were Cessna 337, flying at 205 km/h; Piper Seneca, flying at 240 km/h; Cessna 185 on floats, at 225 km/h; and a Bell 206 helicopter, flying at 160 km/h.

In late May, an attempted survey from Tuktoyaktuk to Baillie Islands revealed very little open water. The first fruitful survey on June 9, dealing with the distribution of the spring sea-bird migration, followed the very intermittent open water patches between Tuktoyaktuk and Baillie Islands, and north along the edge of the large lead that ran up the western shore of Banks Island. These leads were divided into blocks of 5 minutes of flying time, and the species were identified and tallied within each 5-minute block.

On July 7 and 8, eiders nesting in Dolphin and Union Strait, Prince Albert Sound, and Prince of Wales Strait were surveyed. On July 7 we flew with the Piper Seneca along the mainland coast from Pearce Point to Lady Franklin Point (Dolphin and Union Strait), then north along the shore of Victoria Island as far as Read Island, and then on to Prince Albert Sound, the Investigator Islands, and Holman Island. From Holman we used a Bell 206 helicopter to do low-level surveys of the Investigator Islands strung along the north shore of Prince Albert Sound; we landed at several

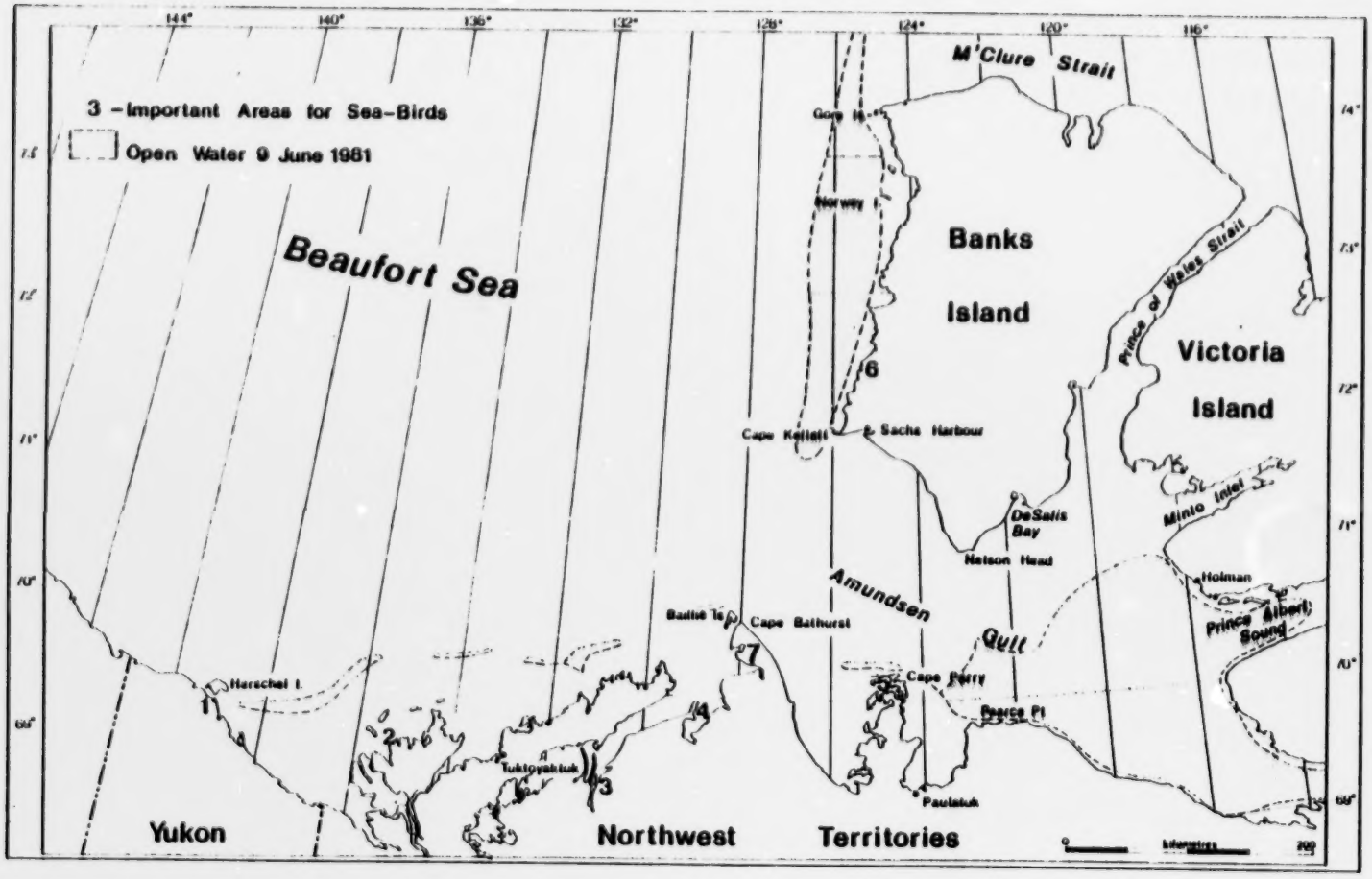

Figure 1. Survey Area.

locations where eider colonies were known from Inuit sources. The following day, July 8, again using the helicopter, we explored the coastline of Minto Inlet, landing at Ramsey Island, and then flew north up Prince of Wales Strait to land at Princess Royal Islands and other sites en route.

The first of three surveys concentrating on molting ducks was flown on July 22 and 23, along the coast from Herschel Island in the west to Baillie Islands in the east. We followed the route used in the 1980 surveys, identifying and tallying birds in approximate 16-kilometer intervals. The other two coastal molting-duck surveys were flown on August 1 and 2 and on August 11 and 12, respectively. A Cessna 185 aircraft on floats was used on the first and third of the molting-duck surveys; a Bell 206 helicopter was substituted on the second survey on account of weather conditions.

An eider crèche survey was flown August 11, following the same route to Lady Franklin Point and Holman Island as in the eider nesting survey of July. This flight was made with a Piper Seneca, and approximate counts and the location of the eider crèches noted.

A fall staging and migration survey was made September 11 along the coast from Baillie Islands to Shingle Point on the western edge of the Mackenzie Delta. The areas to the west of Shingle Point were persistently foggy, and we were unable to examine the vicinity of Herschel Island until several days later. A Cessna 185 on floats was used for this later survey which followed the flight path of the three previous coastal surveys.

On September 24 conditions finally permitted completion of the fall surveys to Amundsen Gulf and Prince of Wales Strait. For the final

part of the survey an Aerostar aircraft was used. Poor weather caused cancellation of late fall surveys planned for October.

All of our observed numbers were weighted according to the size of the areas surveyed, resulting in the density of birds per square kilometer. Because assumptions are necessary for the valid employment of "parametric" statistical techniques, such as the analysis of variance, we used the non-parametric Mann-Whitney (Conover, 1980) and the Wilcoxon Signed-Rank tests (Lehmann, 1975) to compare results of the 1980 season with that of 1981.

Our observations are, of course, affected by weather, light, tides, the flocking nature of molting ducks, and the fact that some observers were different each year. These circumstances strongly suggest that our results can be regarded as carrying information on the order of magnitude (or rank) of species densities only. As such, the non-parametric rank tests, which only require ordinal data, are probably the most efficient methods for analyzing our data.

RESULTS

Ice conditions in May and June presented some problems in conducting the spring ice-edge survey. In late May, the only open water in the Mackenzie region of the Beaufort Sea was a small patch north of McKinley Bay (Figure 1). When we surveyed the edge of the ice in early June, much of the ice between Tuktoyaktuk and Baillie Islands was broken and crushed, but only a few small leads had appeared. The open water north of McKinley Bay was the only well-defined lead. In contrast, Amundsen Gulf was completely ice free, with a vast expanse of open water stretching from near Cape Parry to Holman Island. The lead that usually extends up the western shore of Banks Island at this time of year was 10 to 60 kilometers wide. (Ice conditions of 1981 are reviewed by Parker and Alexander, 1981).

The estimated densities of sea-birds found in the sporadic patches of open water between Tuktoyaktuk and Baillie Islands and in the lead west of Banks Island on June 9 are given in Table 1, while the count of birds observed are in Appendix 1.

In the leads from McKinley Bay to Baillie Islands, old squaw and king and common eider were the predominant species. Loons (yellow-billed, red-throated, and Arctic) and glaucous gulls were seen less frequently, but they were the most consistently observed species. Very few scoters and no scaup were encountered. A consequence of the bad ice conditions in late May were the "wrecks" of eiders in the vicinity of Tuktoyaktuk.

Along the continuous lead west of Banks Island king eiders were seen in the largest numbers: a mean density of 294 birds per square kilometer. King eiders out-numbered common eiders by 15 to 1. Again,

Table 1. Density* of birds along the edge of shore-fast ice on June 9, 1981.

Land mark	Hutchison Bay			McKinley Bay		Cape Dalhousie		Baillie Islands
Old Squaw	-	1.0	1.5	0.4	3.8	54.4	34.6	10.1
Scoter	-	5.6	-	-	0.6	-	-	-
King Eider	3.1	-	-	1.1	2.5	382.0	25.5	49.3
Common Eider	-	-	0.4	2.0	5.8	76.5	16.8	98.0
Loons	-	0.3	0.1	1.0	0.3	1.4	0.1	0.5
Glaucous Gull	0.1	0.3	-	0.3	-	0.5	0.4	1.9
Total	3.2	7.2	2.0	4.8	13.0	514.8	77.4	159.8

Table 1. Continued.

Banks Island (1980 data in parenthsesis)							
Land mark	Cape Kellett						Bernard Island
Old Squaw	0.3	-	0.3	0.3	-	-	0.3
Scoter	-	-	-	-	-	-	-
King Eider	159.1 (18.9)	205.1 (29.6)	173.5 (187.4)	355.5 (267.3)	423.0 (154.0)	423.4 (58.3)	318.0 (0.3)
Common Eider	19.3 (17.3)	19.9 (2.6)	34.0 (1.8)	23.6 (2.9)	0.5 (2.3)	27.3 (1.5)	10.8 (0.0)
Loons	-	-	-	-	-	-	-
Glaucous Gull	0.1	0.4		0.8	0.3	0.4	
Total	178.8 (38.8)	225.4 (32.5)	207.8 (197.2)	380.2 (285.4)	423.8 (164.0)	451.1 (63.5)	329.1 (1.0)

*Birds/km^2

glaucous gulls were not seen in any large numbers, but were evenly distributed. Loons and scoters were not observed at all, and only a few old squaws were noted.

Results of the three coastal molting-duck surveys are presented in Table 2 in the form of densities of birds per square kilometer for the seven major species (scaup, old squaw, eider, scoter, merganser, loon and glaucous gull). The survey route from Herschel Island to Baillie Islands is aggregated from the 16-kilometer segments into the same 15 parts we used in 1980. The observed numbers of sea-birds seen on these three surveys in the 15 parts are in Appendices 2, 3, and 4 respectively.

In Table 3 we present the sea-bird densities in the more important areas which had been rated 1 or 2 in Barry et al. (1981).

Further, in both Table 2 and Table 3 we only give the mean of the three coastal survey densities for each area. In this mean we have excluded any instances of non-observation, i.e. occurrences of zero density. By doing this we hope to reduce the effect that flocks of molting sea-birds have on the probability of making observations, as opposed to the situation in which sea-birds are distributed evenly throughout the survey area. As well, we also hope to cushion the profound effect of weather and the time of day on observations. In both Table 2 and Table 3 we give the comparable data from the 1980 surveys.

The survey of nesting eiders, flown July 7 to Lady Franklin Point, then to Read Island and on to Holman Island, revealed strings of eiders still migrating eastwards along the mainland coast. These flocks, consisting of both males and females, often totaled upwards of 300 birds and were encountered along approximately every 8 to 16 kilometers of shoreline.

Table 2. Mean sea-bird densities* during coastal surveys, July-August.

Land mark		Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	1981	13.1	6.4	0.4	-	0.1	16.6	38.2	16.1
	1980	5.0	4.7	1.7	0.1	0.1	22.3	126.9	30.7
Old Squaw	1981	63.4	7.8	1.4	0.03	0.04	11.0	32.7	17.3
	1980	230.7	3.3	0.9	0.1	0.2	2.3	2.2	7.5
Eiders	1981	1.8	0.2	0.4	-	0.4	-	0.1	-
	1980	3.3	0.4	0.3	0.1	0.1	0.1	0.1	0.1
Scoter	1981	66.5	3.1	3.5	-	-	7.0	4.9	16.3
	1980	594.8	0.7	0.7	1.3	0.3	5.1	7.8	10.3
Merganser	1981	0.6	2.0	0.1	-	-	9.5	0.7	5.4
	1980	-	-	1.9	-	0.02	-	3.2	1.2
Loons	1981	0.3	0.6	0.6	0.3	0.2	0.6	0.5	0.2
	1980	0.3	0.4	0.4	0.4	0.1	0.1	0.6	0.9
Glaucous Gull	1981	5.7	5.7	18.7	0.6	9.5	14.7	7.9	9.7
	1980	2.0	1.4	3.9	10.2	3.9	7.0	4.5	6.2

Table 2. Continued.

Land mark		McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Bay	Ikpisugyuk Bay	Harrowby Bay	To Cape Bathurst
Scaup	1981	7.3	10.6	21.0	17.0	70.3	19.6	21.6
	1980	14.7	17.4	83.2	18.0	88.8	57.8	1.4
Old Squaw	1981	85.8	27.1	40.3	8.1	15.0	35.2	42.8
	1980	29.0	38.2	35.0	103.6	9.7	55.6	42.1
Eiders	1981	9.4	1.0	0.5	0.6	22.6	1.9	13.6
	1980	0.1	0.1	0.1	0.1	6.0	2.6	28.7
Scoter	1981	56.4	16.6	20.3	3.3	4.5	52.5	6.1
	1980	28.5	18.2	29.6	236.0	28.3	8.7	5.6
Merganser	1981	0.5	1.2	2.5	2.9	6.2	0.6	0.9
	1980	3.6	2.6	2.6	4.0	4.1	2.0	0.9
Loon	1981	0.3	0.6	0.4	0.5	0.3	0.2	0.4
	1980	0.7	0.4	0.7	1.0	0.4	0.5	0.2
Glaucous Gull	1981	6.8	5.9	4.5	5.0	2.2	3.5	6.2
	1980	5.5	2.9	1.6	5.5	5.7	6.4	5.5

*Birds/km^2

Table 3. Mean densities of (Birds/km^2) in important areas during July and August.

Land mark		Herschel Island	Pelly Island to Kendall Island	Wood Bay	Harrowby Bay
Scaup	1981	13.1	-	18.9	17.8
	1980	6.4	0.1	66.9	57.9
Old Squaw	1981	63.3	-	26.2	32.0
	1980	197.5	2.9	28.1	46.6
King Eider	1981	1.6	-	0.1	0.5
	1980	3.4	-	-	-
Common Eider	1981	0.2	-	0.3	1.2
	1980	2.6	-	-	4.0
Scoter	1981	66.4	-	13.1	47.7
	1980	509.2	-	27.2	70.6
Merganser	1981	0.6	-	2.5	0.6
	1980	-	-	2.1	1.3
Loon	1981	0.3	0.5	0.4	0.2
	1980	0.3	0.1	0.5	0.4
Glaucous Gull	1981	5.7	13.4	5.3	3.1
	1980	2.5	16.0	1.5	4.6
Survey Area (km^2)	1981	29.5	17.1	39.1	27.9
	1980	1!.9	7.0	38.1	24.8

As well, we also observed many flocks of immature glaucous gulls gathered at nearly every creek and river outlet along the shoreline. These flocks would often total 200 to 300 individuals.

Of particular interest on this survey were the low rocky islands in Dolphin and Union Strait and along the southwest shore of Victoria Island in the vicinity of Read Island. Although many of these islands, in particular Camping Island, have suitable habitat, we did not find indications of large numbers of eiders nesting in the vicinity. On the small Ivonayak Island, however, and also on a small unnamed island in Austin Bay, north of Lady Franklin Point, we did find indications of eiders on nests. McLaren and Alliston (1981) found 319 nests on this island in 1980.

Our survey by helicopter July 7 of the Investigator Islands along the north shore of Prince Albert Sound revealed two islands on which common eiders were nesting in colonies. The first of these islands, 4.0 hectares in extent, had 500 to 600 pairs in the colony. The mean clutch size of 47 of these nests was 3.77. The mean clutch size for 15 nests on the second island (1.6 hectares) was 3.53. Approximately 100 pairs of eiders were using this second island. Observations of the number of males still around, and of the amount of down present in the nests indicated that nest initiation and egg-laying were still in the early stages.

The smaller of these two islands was the highest in elevation (3-4 meters). It was formed mainly of gravel and bedrock strewn with an assortment of large and small boulders, most of them covered with orange lichen. Other vegetation was scarce: moss on the surface of the island and deposits of sea-wrack on the gravel beach.

The second island was relatively low (1-2 meters) and quite barren, consisting mostly of gravel. Large deposits of sea-wrack lay on the beach. Most of the eiders nesting there were using less than a quarter of the island, seeming to prefer the occasional small patches of grass and sedge for nest sites. In one grassy area, about one square meter in extent, seven nests were crammed together.

At the several other islands in this group we saw no evidence of nesting, although there were groups of male and female eiders in the sea and on the ice nearby.

Eiders were still migrating in Minto Inlet at this time. Along 100 kilometers of coastline northwards from Holman Island we observed many flocks, totalling 5,800 birds.

The sea from Minto Inlet north was ice-covered, very different from conditions in Prince Albert Sound where most of the Investigator Islands were in or close to open water. We saw only one flock of 100 eiders between Minto Inlet and Berkeley Point. At Ramsey Island there was no open water. We did see a flock of 100 common eiders in the vicinity and flushed several female eiders from suitable nesting habitat, but found no nests. This indicates that at this latitude, with no open water, the eiders nest much later than they do further south where there was open water in proximity to the nesting sites. A similar north-and-south differential in nesting starts was noted by McLaren and Alliston in 1980 (1981).

From Berkeley Point to the Princess Royal Islands the ice was solid and tight against the shore. The only eiders we saw along this stretch were many females, probably king eiders, flushing from inland tundra pools.

At the Princess Royal Islands the tides and currents created 100 to 200 meters of open water surrounding and between both islands, the only open water for many kilometers. In the vicinity we observed 175 king eiders, 250 common eiders, and two pairs of murres. On the islands themselves we found at least 10 pairs of eiders, 40 pairs of glaucous gulls, and 10 pairs of Thayer's gulls, all apparently ready to nest.

The portion of the August 10 survey of eider crèches between Pearce Point and Cape Young showed small flocks of female eiders with young, totalling 502 birds. In Dolphin and Union Strait we saw 550 females with young around Camping Island and another 250 around the smaller Douglas Island just off Lady Franklin Point. On Ivonayak Island crèches totalling 500 birds were seen. In the Investigator Islands we tallied 1,443 females and young in a 27-kilometer stretch, a density of 133.7 per square kilometer. The areas north of Holman Island were fogged in hence we were unable to investigate them.

The early fall survey on September 11 of migrants in the Beaufort Sea showed that the sea-birds were still distributed as they had been during the summer, although not in as large numbers. In some places, however, certain species showed an increase in density, for example glaucous gulls at Nunaluk Spit and at Kay Point, mergansers at Shingle Point, old squaw at Hutchison Bay, and scaup in Wood Bay and Harrowby Bay. Densities of sea-birds along this survey route are in Table 4 and the observed numbers in Appendix 5.

The late fall migration survey to Holman Island on September 24 showed numerous eiders still present in spite of the beginning of freeze-up along the shore. En route to Holman Island, along the west side of Parry Peninsula from Langton Bay to Cape Parry we counted 1,304 eiders,

Table 4. Fall Survey: September 11 - densities* of birds.

Land mark	Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	-	-	-	-	-	-	20.0	16.9
Old Squaw	3.1	1.7	1.3	-	-	0.1	24.5	143.7
Eiders	-	0.7	-	-	-	-	0.03	-
Scoter	0.7	0.3	-	-	-	-	9.4	8.5
Merganser	-	-	12.2	-	-	9.9	10.3	0.6
Loon	-	-	0.1	-	0.1	0.1	-	0.1
Glaucous Gull	20.7	22.5	15.6	0.1	8.8	7.0	7.9	2.4

Table 4. Continued.

Land mark	McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Point	Ikpisugyuk Bay	Harrowby Bay	Cape Bathurst
Scaup	0.9	0.8	25.3	17.4	17.3	44.5	-
Old Squaw	3.3	30.2	0.7	77.1	60.9	16.7	2.5
Eiders	-	1.4	-	-	-	0.7	1.7
Scoter	16.1	1.1		0.1	1.3	1.7	0.04
Merganser	-	0.02	-	1.2	3.1	2.6	-
Loon	-	0.2	-	0.1	0.5	0.3	-
Glaucous Gull	10.7	2.8	2.0	1.6	1.6	2.0	6.3

*Birds/km^2

314 old squaws, 1,239 glaucous gulls (1,100 in one flock), and two yellow-billed loons. Most of the eiders were in crèches, and it appeared that 10-15 percent of the birds still could not fly. Occasionally a few male eiders in eclipse plumage were seen among the flocks.

In the Investigator Islands we observed only 215 eiders, 824 glaucous gulls, and 3 old squaws, while from Berkeley Point north to the Princess Royal Islands we counted 1,810 eiders, 260 glaucous gulls, and two yellow-billed loons.

DISCUSSION

The location and abundance of open water in the Beaufort Sea in the spring of 1981 differed considerably from the previous year (Barry et al., 1981; Parker and Alexander, 1981), and so did the migration patterns of some sea-birds.

In the spring of 1980 only one lead was open, but it stretched offshore from near Pullen Island in the Mackenzie Delta to Baillie Islands in the east. It then traversed Amundsen Gulf to Cape Kellett on Banks Island and ran north along the western shore of the island. This provided a huge expanse of open water averaging 20 kilometers in width, its southeastern edge running nearly 750 kilometers from the Mackenzie Delta to the northwestern corner of Banks Island. The 1980 spring migrants thus encountered nearly 15,000 square kilometers of open water over which to disperse, and much of this water was less than 30 meters deep, allowing bottom feeding.

In 1981, however, only the portion of the usual Beaufort Sea lead that runs along the west shore of Banks Island had opened by early June. To the east of the Mackenzie Delta, off the mainland coast, the only clearly defined lead lay north of McKinley Bay, and only a few small and unstable leads were opened by the strong currents near Baillie Islands. Yet, while little open water was available in this part of the Beaufort Sea, the whole eastern three-quarters of Amundsen Gulf, from Cape Parry to Holman Island, was open.

These conditions forced the migrating sea-birds that stopped in the southeastern Beaufort Sea to crowd into the limited open water there.

The effect of this lack of open water off the Tuktoyaktuk Peninsula on the density of sea-birds is quite striking. In early June, 1980, the mean density of all species observed between McKinley Bay and Baillie Islands was 19 birds per square kilometer, while in 1981, with much less open water available, we saw birds in this area at a rate of 154 for every square kilometer surveyed, a highly significant difference (Mann-Whitney $P < .001$). Similarly, along Banks Island both king and common eider densities were significantly greater than those recorded in 1980 (Wilcoxon signed-rank $P < .05$). Together, the density of the two eider species in this area tripled from 106 in 1980 to 313 birds per square kilometer in 1981.

Another aspect of a late ice year such as 1981 is the effect on migrating eiders while they are still in Alaskan waters. Some of the birds encountering heavy continuous ice there evidently hang back, stringing out the period of migration (Johnson and Richardson, 1981). This phenomenon seems to affect the two eider species differently.

Because king eiders nest on the many tundra lakes and ponds on Banks and Victoria Island that fill with melt-water by the middle of June, they are geared to nest shortly after the onset of the spring thaw, a process which is fairly regular from year to year. Consequently, these birds push on during spring migration, regardless of ice conditions, since the clearing of their inland nesting sites is generally unrelated to conditions on the sea.

Common eiders on the other hand, nest much later in areas from the Beaufort Sea to Coronation Gulf that do not become ice-free until late June and early July, and they are probably not adversely affected by delaying their migration eastward from Alaska. Moreover, the western race

of common eiders is able to nest individually, as well as in small loose groups, on the barrier beaches and rocky points. These locations are usually bordered with open water even when the island sites of their traditional colonies are not yet cleared.

This dependency of common eiders on the presence of open water near the nesting site was clearly demonstrated in 1981 when the contrasting conditions of open water in Prince Albert Sound and ice in Minto Inlet coincided with the presence or absence, respectively, of nesting eiders. McLaren and Alliston (1981) also found similar differences in nesting dates of common eiders on western Victoria Island.

Our 1981 surveys in July and August of nesting eiders and eider crèches in Dolphin and Union Strait and the Victoria Island-Prince of Wales Strait were able to account for only a small percentage of the common eider populations usual in this region. Of the several islands checked in Dolphin and Union Strait in early July, only four had any sort of eider population. The same situation existed in Prince Albert Sound. Possibly, many eiders that ordinarily occupy Dolphin and Union Strait did not nest there this year, and the large numbers of eiders observed between Pearce Point and Cape Young may have been heading on to Coronation Gulf farther to the east. Their status as residents that failed to nest, or as birds still in migration is unclear, since on a single day in early June 1980, rafts of eiders totalling 18,000 birds were observed from a point on the mainland opposite Lady Franklin Point (L. Allen, pers. com.).

The flight path of our 1981 coastal surveys of molting and brood-rearing flocks of sea-birds was designed to follow the routes used for the similar series of surveys flown the previous season. As was the case in 1980, fog and bad weather interfered, preventing us from flying on

exactly the same dates as the year before or forcing us at times to fly along slighlty different routes. Generally speaking, however, the areas with the highest densities of sea-birds proved to be the same as we found in 1980.

The densities of birds either increased or decreased from 1980 to 1981 depending on the species and the location. Nevertheless, only four of the 15 divisions of the survey (Table 2) exhibited any overall significant change in sea-bird density (Wilcoxon Signed-Rank $P < .05$): Herschel Island to Kay Point, an increase from 1980 to 1981; and Shallow Bay, Wood Bay to Maitland Point, and Harrowby Bay, all with a decrease in sea-bird density. Only two species showed any consistent change ($P < .05$) in our survey of coastal habitat: Scaup were generally seen in fewer numbers in 1981, while glaucous gulls were seen more frequently.

The following discussion deals only with the eleven important sections of coastline between Herschel Island and Baillie Islands that we rated as 1 or 2 in our report of the 1980 season.

In 1981 all of the areas which in 1980 had the highest densities of molting sea-birds, again had large numbers of birds. Statistically, at only two of these sites did the mean density of sea-birds change significantly from one year to the next (Wilcoxon Signed-Rank $P < .05$). In Phillips Bay densities increased, while in Harrowby Bay a decrease was noted, mainly in scaup, old squaw, and scoter. This significant decline in scaup density was also generally found in the other important areas. Only merganser (Wilcoxon Signed-Rank $P < .1$) and glaucous gull ($P < .05$) showed any overall significant increase in our 1 and 2 rated areas.

The fall staging and migration survey of the Beaufort Sea coast revealed a completely different picture of the distribution of sea-birds

from what we found in 1980. In early September of 1980 most of the birds were to the west of the Mackenize Delta, with large numbers of scaup, scoters, and old squaws in the vicinity of Herschel Island. To the east there were only a few small scattered flocks of these birds.

Only glaucous gulls followed this pattern in 1981. We found the larger numbers of sea-ducks to the east of Tuktoyaktuk. Scaup and old squaw were particularly dense in the sheltered bays between Wood Bay and Harrowby Bay. Undoubtedly, the persistent fog and September snow storms to the west of the Mackenzie Delta, which hampered our surveys, also prevented a westward movement of these birds.

The large numbers of glaucous gulls, eiders, and old squaws seen along the Parry Peninsula and in Prince of Wales Strait in late September, 1981, indicate that a second wave of migrants enters the Beaufort Sea later in the year. Probably, these are mostly birds from the high Arctic and late-nesting female eiders with young. Others are probably late molters which are finally forced out by the onset of freeze-up.

SPECIES ACCOUNTS

Highlights of the distribution of the seven major groups of sea-birds examined in 1980 and 1981 are as follows:

Loon (yellow-billed, red-throated, Arctic)

During the ice-edge survey of the spring of 1980 Arctic and red-throated loons were seen more frequently between Tuktoyaktuk and Nuvorak Point than elsewhere. In 1981 most of the spring migrants were seen between McKinley Bay and Baillie Islands, their presence undoubtedly influenced by the available water there.

On the coastal surveys of 1980 and 1981 these species were consistently seen at a rate of one or two birds for every two square kilometers surveyed from Herschel Island to Baillie Islands. In the fall, this rate dropped to about one bird for every 10 square kilometers. Overall, no significant change in density was noted from 1980 to 1981.

Yellow-billed loons appear to be late fall migrants, several being seen along Parry Peninsula and in Prince of Wales Strait in late September.

Scaup

No scaup were seen in the areas covered by the 1981 spring survey. Scaup that use the littoral zone of the Beaufort Sea are predominantly males, which arrive in a molt migration in late June and early July, after nesting has begun further south. During July and August most of the molting flocks are found to the east of the Mackenzie Delta, the important areas being from Tuktoyaktuk to Atkinson Point, Wood Bay, Ikpisugyuk Bay, and Harrowby Bay.

Although the density of scaup decreased significantly from one season to the next, these same areas were important in both years. On the 1981 fall surveys we found that many scaup were still present in large numbers in the important areas mentioned, but there were very few elsewhere.

Old squaw

In the spring of 1980 migrating old squaws were widely spread over the abundant open water. In 1981, however, these birds were concentrated in the small leads between Cape Dalhousie and Baillie Islands, and off McKinley Bay.

Very few old squaws were seen along the western shore of Banks Island in 1981, although densities there were as high as 14 birds per square kilometer. In both 1980 and 1981 the important molting areas were Nunaluk Spit-Herschel Island and from McKinley Bay to Baillie Islands, but in 1981 also included the stretch from Tuktoyaktuk to Atkinson Point.

The bays to the east of Tuktoyaktuk were found to be important fall staging areas for these birds.

Eider (King and Common)

The spring surveys of 1980 showed the separate distribution of common and king eiders in the Beaufort Sea. The large amount of open water available that year permitted common eiders to gather almost exclusively along the edge of the shore-fast ice of the mainland coast, from the Mackenzie Delta eastwards to the north end of Franklin Bay. On the other hand, very few king eiders were in this area, but instead predominated along Banks Island.

In 1981, when the leads were only intermittent, king eiders predominated over common eiders in the Cape Dalhousie-Baillie Islands

leads. West of Banks Island both species were seen in larger numbers in 1981 than the year before, although common eiders were again greatly outnumbered by king eiders. Only at Herschel Island and between Ikpisugyuk Bay and Baillie Islands were numbers of eiders seen during July and August, and these were local nesters.

Scoter

Very few scoter were seen on the spring surveys of either year, for, like scaup, male scoters do not arrive in the littoral zone to molt until after the females have begun to nest in the inland areas. Our July and August coastal surveys showed that they then gather in the same select areas as scaup and old squaw, namely at Herschel Island and from Tuktoyaktuk to Harrowby Bay.

Local increases or decreases in density of scoters were noted from 1980 to 1981, and were in all likelihood a factor of weather and the time of day of the surveys. Overall, however, there was no significant change in scoter densities from one year to the next. With the exception of McKinley Bay, very few scoter were seen on the fall surveys in early September.

Merganser

No mergansers were observed migrating during our spring surveys. Nor were they seen in large numbers in any one area during July and August, since mergansers, like loons, are evenly distributed from Herschel Island to Baillie Islands.

In the fall, larger numbers of mergansers were seen in several areas west of Hutchison Bay and in Ikpisugyuk and Harrowby bays.

Glaucous gull

In the spring glaucous gulls were seen consistently and, like loons, were widely distributed. On our coastal surveys of 1981 we found a significant increase in the density of gulls in the important 1- and 2-rated areas. The high densities of gulls in certain of these places, for example in Shoalwater Bay, are influenced by the presence of gull colonies and human activity such as the Shingle Point Dew-line station.

By early September many gulls had moved to the west, higher densities being found in 1981 from Blow River to Herschel Island.

IMPORTANT AREAS FOR SEA AND COASTAL BIRDS

From the surveys in 1980 and 1981 and from other work done in the Beaufort Sea region we have found areas that repeatedly attract comparatively high densities of sea and coastal birds. In the past, we have made lists of critical or important areas for waterfowl and sea-birds (Barry, 1960, 1976, 1981, etc.), and have found these lists unsuitable for generalizations because of diverse objectives and requirements.

In our report on the surveys of the 1980 season we established coastal habitat ratings ranging from 1, extremely important, to 5, nil importance, which we feel reflect the relative value of various parts of the coastline to birds. We have now selected seven of these places that were originally rated 1, 2 or even 3 in the 1980 surveys which we regard as having the highest value for sea and coastal birds.

Our criteria for selection are somewhat different or each area, but generally are based upon numbers, density, and the diversity of species, and on the uniqueness of species and habitat. The frequency of use from year to year and the phases in the birds' life-cycle during which the areas are used also entered into our appraisal. Most, but not all of these seven areas include Migratory Birds Sanctuaries established in 1961.

Figure 1 gives the locations of these seven areas which are:

1. Herschel Island
2. Outer Mackenzie Delta (Pelly and Kendall islands)
3. Campbell Island-Kugaluk Estuary
4. Wood Bay (Anderson River Delta to Mason River Delta)
5. Cape Parry including (Booth Islands)

6. West side of Banks Island (Cape Kellett to Gore Islands)

7. Harrowby Bay (Old Horton River Bed)

Brief descriptions follow.

1. Herschel Island (Ptarmigan Bay to Workboat Passage)

The area includes the shores and waters off the south and east coast of Herschel Island and along the adjacent Yukon Coast from the base of Nunaluk Spit to Catton Point. The mainland coast is low and sandy, featuring the braided deltas of the Malcolm and Firth rivers. Nunaluk Spit forms a 25-kilometer sandspit off the fan deltas. Workboat Passage between Herschel Island and the mainland is noteworthy for its strong tide-rips at each end, between Avadlek Spit and Nunaluk Spit to the west, and between Osborn and Catton points to the east.

Herschel Island rises to nearly 180 meters, with mud seacliffs on all sides except along Workboat Passage. Pauline Cove has been a ship anchorage since whalers first used it during the 1890s.

The waters around Herschel Island provide an interspersion of marine and coastal habitats supporting a diversity of species. The slope and the river deltas are used by large numbers of snow geese during the fall staging in late August and September.

Our surveys show that Workboat Passage has some of the highest densities of sea-bird use for nesting, molting, and feeding. From six surveys done in 1980 and 1981 the mean densities for representative sea-birds are found in Table 3.

During late July and August a variety of shore-birds migrate both eastward and westward through Workboat Passage, depending on the wintering destinations of the species. Flocks stop to rest and feed on the mud-flats and fan deltas. As many as 5,000 red phalaropes may be found

feeding in the surf at Nunaluk and Avadlek Spits in mid-August. In addition to the snow geese that stage in the area in the fall, approximately 26,000 brant feed on the vegetated flats and lagoons and migrate westward along the littoral zone in early September. Glaucous gulls, common eiders, and in some seasons brant, Arctic tern and Sabines gulls nest on Nunaluk Spit or the islands off the east end. The abandoned mission building at Pauline Cove is the site of the only known stable nesting concentration of guillemots in the western Canadian Arctic since at least 1958.

2. Outer Mackenzie Delta (Pelly and Kendall islands)

This area includes parts of the old pre-glacial delta of higher ground, e.g. Pelly Island and Kendall Island. About one-third of the area is new delta, and is comprised of low flats developed from silt deposition. The low deltaic islands are covered with sedges, grasses, or equisetum, and can be quite marshy. Storm tides may be expected in late summer and fall. The higher islands are more uniformly covered with willows and dwarf birch.

The turbid, shallow, nearly fresh waters of the Mackenzie River seem to be used mainly by glaucous gulls. Our three summer surveys of sea-birds carried out in 1980 and repeated in 1981 show low mean densities (Table 3).

The area just on-shore, however, is much more significant for birdlife. Approximately 150 pairs of whistling swans nest on both the low flats and the uplands. Also about 500-1000 non-breeding swans gather in pre-molting flocks in Swan Channel, and on south Kendall Island and Pelly Island.

The group of four low islands south of Kendall Island is a nesting colony for snow geese, for which there are records as early as 1850. In 1981, 1,000 nesting geese were counted there from aerial photographs. The number of snow geese using this area has ranged from near zero to 8,000 since the 1950s.

Pacific brant nest at scattered points, and a colony of up to 50 pairs nests on Pelly Island and its sandspit. White-fronted geese are scattered nesters, but in early July up to 2,500 non-nesting sub-adults gather to molt on traditional gounds along Harry Channel and Dennis Lagoon.

Sandhill cranes nest widely across the outer delta. Pintail, mallard, widgeon, and scaup nest around the lakes and marshes. Shore-birds are abundant, and the rather uncommon Hudsonian godwit is found in select habitat of willow-grass edge. Part of the area is within the Kendall Island Migratory Birds Sanctuary.

3. Campbell Island-Kugaluk Estuary

This area lies at the western end of Liverpool Bay and includes parts of the "fingers" of Eskimo Lakes, which are the glacially-distorted remnants of an old Mackenzie River Delta. The south shore of Tuktoyaktuk Peninsula here is moraine, and most of the country is rolling hills about 30 meters high, covered with scrub willow and dwarf birch. The seacliffs and beaches are generally sand or silt.

Campbell Island and the deltaic flats of the Moose and Smoke rivers and the Kugaluk and Miner rivers are low, vegetated with meadows and marshes of sedges and grasses.

The waters of Liverpool Bay around Campbell Island are shallow, but within the fingers and in Kugaluk estuary they may be as deep as 30

meters. Strong tidal currents occur in the passage north around the fingers.

There is a run of herring under the ice of Liverpool Bay, and where open water occurs in June e.g. along the Moose River flats and around Thumb Island, fish-eating birds can be found in large numbers, in some years as many as 3,000 red-breasted and common mergansers and 1,000 sub-adult glaucous gulls.

Investigations of a glaucous gull colony of approximately 100 pairs on a small island north of the flats show they feed on fish for a brief period in the spring before turning almost exclusively to blue mussels.

The flats of Campbell Island, Moose River delta, and Kugaluk River delta are important molting grounds for non-breeding swans (500), white-fronted geese (7,000), and Canada geese (10,000 to 15,000) during July and early August. Some of these species also nest there as do snow geese and brant.

Three surveys of molting ducks, etc. in July and August of 1980 gave the following densities per square kilometer:*

Loon	.5
Scaup	20.9
Old squaw	14.0
Eider	0.0
Scoter	59.1
Merganser	15.2
Glaucous gull	9.4

*Transect length 55.6 kilometers; area 22.2 square kilometers.

4. Wood Bay (Anderson River Delta to Mason River Delta)

Wood Bay is named for the abundant supply of driftwood carried down the Anderson River at spring breakup and eventually deposited on the bay's treeless shores. Nicholson Island, which forms the northwest shore of Wood Bay, is the result of a glacial thrust from the west. The coast is receding, and, until a storm on 17 August 1964, Nicholson was a peninsula, as shown on most maps. From subsequent storms and strong tide-rips the breakthrough, Squaw Duck Channel, has widened to nearly 1,000 meters and is now from 1.5 to 6 meters deep.

Much of the east side of the bay is unglaciated (a refugium), and with the exception of the river deltas, the surrounding countryside is low rolling hills. The beaches are variable: gravel, sand, or clay-silt. Seacliffs with frequent ice lenses and slumping are common away from the river deltas.

The deltas themselves are low, very muddy, and are progressively more densely vegetated as one moves upstream.

The Anderson River delta and, to a lesser extent, the Mason River delta are diverse in wildlife habitats. There are nest sites of peregrine falcons and golden eagles in each delta. The area supports a colony of snow geese of 2,500 to 8,000 birds. Up to 2,500 brant nest there. Approximately 75 pairs of swans nest, and 1,200 non-breeding swans gather in pre-molting flocks. Both the Anderson and Mason rivers have molting flocks of about 1,000 white-fronted geese each. White-fronted and Canada geese are scattered nesters along tributary streams. The yellow-billed loon is regularly found from Mason River northwards; red-throated and Arctic loons are common nesters throughout the area. Puddle ducks and diving ducks nest in both deltas. Pintail, widgeon, and scaup often

appear in post-nesting flocks of up to 1,000 individuals.

Twenty-six species of shore-birds, many of them nesters, have been identified in the area. The flats and shore-line attract many flocks during spring and fall migrations. The variety of passerine birds is high for the north, and a number of northern nesting records occur here. There are three glaucous gull colonies around Wood Bay.

Results of July and August surveys give the densities of sea-birds (Table 3).

Part of the area is covered by the Anderson River Migratory Birds Sanctuary, which was established in 1961.

5. Cape Parry (Booth Islands)

The tip of Parry Peninsula is predominantly exposed limestone bedrock with little over-burden, and that mostly fractured rock. The coastline is deeply incised into numerous bays. The shores are either rock seacliffs up to 20 meters high, or shingle and gravel beaches in protected bays and occasion spits. There is little vegetation except for a few marshy swales.

Where Cape Parry juts out into Amundsen Gulf and separates Franklin Bay from Darnley Bay the marine currents and the variability of depths apparently result in upwellings that provide for a rich marine environment. Furthermore, in spring there is often open water or leads in the ice near the cape and islands, a polynya effect which was more regular prior to 1970, but nonetheless persists sufficiently to allow open water in June.

In early June approximately 20,000 king eiders, common eiders, and old squaw ducks can be expected when the open water is close to Fiji Island, Canoe Island, and the west point (Police Point) of Cape Parry.

Scattered among these flocks were murres, Arctic loons, and yellow-billed loons, are often found.

Later in the season about 800 thick-billed murres and from 4 to 12 black guillemots nest on Police Point. Common eiders nest on the islands and beaches of Parry Peninsula.

The Cape Parry Migratory Birds Sanctuary covers only a small portion of the area, i.e. the tips of the three points of the cape, and is designed to cover only the nesting and potential nest cliffs of the murres.

6. West side of Banks Island (Cape Kellett to Gore Island)

The west side of Banks Island has a low gentle coast. The island is for the most part unglaciated. A series of westward-flowing rivers drains nearly half the island through broad valleys; their flat, braided deltas have barrier beaches, spits and lagoons. The valleys and deltas are generally well vegetated. Offshore, a lead forms nearly every spring along the edge of the shore-fast ice in about 15 to 20 meters of water; an exception was 1964 when the lead remained closed.

The open-water lead along west Banks Island, and its extension along the shear zone from Baillie Islands westward along the mainland coast and off Alaska have become a traditional migration route for eiders and other marine birds. If the coastal flaw lead becomes intermittent, king eiders fly on, depending on the Banks Island lead to be open.

King eiders, which generally nest further north than common eiders, are more frequently found in the Banks Island lead, as early as 25 April through June. A series of seven transects flown along the ice edge from Cape Kellett to Bernard Island on 5 June 1980 and 9 June 1981 showed the following densities and ratios of the two species of eider:

Density of king and common eiders per km^2

Transects 1980	Common	King	C/K ratio
1 (Cape Kellett)	17.3	18.9	1:1
2	2.6	29.6	1:11
3	1.8	187.4	1:100
4	2.9	267.3	1:91
5	2.3	154.0	1:67
6	1.5	58.3	1:39
7 (Bernard Island)	0.0	0.3	—

Transects 1981	Common	King	C/K ratio
1 (Cape Kellett)	19.3	159.1	1:8
2	19.9	205.1	1:10
3	34.0	173.5	1:5
4	23.6	355.5	1:15
5	0.5	423.0	1:846
6	27.3	423.4	1:15
7 (Bernard Island)	10.8	318.0	1:29

An estimated 500 common eiders remain along the coast to nest on barrier beaches and islands. King eiders nest inland near tundra pools and lakes; when conditions are good and numbers at their peak, the total on Banks Island may be as many as 100,000 individuals.

Onshore, 200,000 snow geese (from air photos) nest in the valley of the Big River. From 1,000 to 3,000 brant nest in the deltas and inland. Old squaws, glaucous gulls, Sabines gulls, and red phalaropes are among the more numerous nesters in the coastal habitat.

The west side of Banks Island from Cape Kellett to the Bernard River is in the Banks Island Migratory Birds Sanctuary #1.

7. Harrowby Bay (Old Horton River Bed)

Harrowby Bay is the former delta and outlet of the Horton River, which broke through the Smoking Hills in about 1800 to form a fan delta in Franklin Bay (Mackay, 1981). The perched valley and delta of the lower Horton River thereupon ceased further delta development, and the receding (sinking) coastline has allowed the bay to extend into the last two bends of the river to form an estuary.

The surrounding country is rolling hills 30 meters high, rising to 90 meters or more at the Smoking Hills seacliffs on Franklin Bay.

The south side of Harrowby Bay inshore of the barrier beaches and spits is low and marshy, rising in a series of river terraces to the plateau to Ikpisugyuk Bay. The north shore of Harrowby Bay has some low sea cliffs, and gravel and sand beaches and spits northwest towards the sea. The bay's wide mouth is fully open to the Beaufort Sea.

The Old Horton River Bed is lushly vegetated with sedges and grasses, and is an extremely important molting and feeding ground for non-breeding Canada and white-fronted geese. From 25 June until 5 August flocks of flightless geese numbering up to 20,000 or more can be found concentrated in the old valley.

Golden eagles nest in the soft shale cliffs overlooking the goose concentrations which furnish them a source of food.

In some seasons, usually when spring snow conditions are poor on Banks Island, up to 5,000 snow geese have nested to the east and north of North Star Harbour. In fall (late August to early September) the same

area is usually the first landfall of Banks Island snow geese, which gather in large flocks.

Along the flats, beaches, and islands of Harrowby Bay there are scattered nests of common eiders, glaucous gulls, pintails and swans. On our surveys of sea ducks, etc. in 1980 and 1981 we found good concentrations as shown in Table 3.

CONCLUSIONS

Of the thousands of kilometers of littoral and coastal waters along the Canadian shores of the Beaufort Sea and its marine approaches, some places attract relatively few sea-birds, either in number or kind. In other places, important for migration, nesting, molting and feeding, we regularly find more diversity of species, as well as large numbers of birds. Within a single season, moreover, the concentrations of birds shift from place to place, depending on the timing and requirements of each phase in the life cycles of the various species.

The vulnerability of sea and coastal birds to environmental changes will be greatest wherever and whenever the densities of birds are highest. The high densities of flightless flocks of molting scaup, scoters and old squaws etc. found in certain bays indicate the importance of these places.

We have designated seven habitat areas for having high value to sea and coastal birds in the Beaufort Sea region.

Despite differences in ice conditions, the birds concentrated in the same areas in 1980 and 1981. The more extensive ice coverage during the spring of 1981 resulted in higher densities of birds in the open water that did exist and was available for spring staging. During the molt, however, the density of sea-birds in some areas tended to be lower in 1981 than in 1980. Furthermore, adverse weather conditions during the fall of 1981 appeared to cause bird concentrations for fall staging to shift eastwards of the Mackenzie Delta from sites used in 1980.

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Appendix 1. Spring Survey: June 9 1981, observed numbers. Survey Area = 8.0 km^2 per transect.

Land mark	Hutchison Bay			McKinley Bay		Cape Dalhousie		Baillie Islands
Old Squaw	-	8	12	3	30	435	277	81
Scoter	-	45	-	-	5	-	-	-
King Eider	25	-	-	9	20	3056	204	394
Common Eider	-	-	3	16	46	612	134	784
Loons	-	2	1	8	2	11	1	4
Glaucous Gull	1	2	-	2	-	4	3	15
Total	26	57	16	38	103	4118	619	1278

Appendix 1. Continued.

Land mark	Cape Kellett						Bernard Island
Old Squaw	2	-	2	2	-	-	2
Scoter	-	-	-	-	-	-	-
King Eider	1273	1641	1388	2844	3384	3387	2544
Common Eider	154	159	272	189	4	218	86
Loons	-	-	-	-	-	-	-
Glaucous Gull	1	3	-	6	2	3	-
Total	1430	1803	1662	3041	3390	3608	2632

Appendix 2. Coastal Survey No. 1: July 18, 1981, observed numbers.

Land mark	Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	145	47	-	-	-	100	624	637
Old Squaw	1248	109	3	-	-	864	1096	874
Eiders	49	5	1	-	2	-	4	-
Scoter	2644	61	2	-	-	116	206	600
Merganser	16	8	-	-	-	7	33	51
Loons	19	23	10	-	-	2	22	4
Glaucous Gull	278	111	530	18	508	526	328	288
Survey Area (km^2)	36.83	23.11	28.45	38.74	48.90	37.34	30.48	19.30

Appendix 2. Continued.

Land mark	McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Point	Ikpisugyuk Bay	Harrowby Bay	Cape Bathurst
Scaup	53	1128	196	25	674	280	
Old Squaw	1007	3878	728	119	128	1284	654
Eiders	-	11	1	14	16	15	21
Scoter	150	1831	262	74	69	660	1
Merganser	3	25	2	4	4	4	12
Loons	3	57	9	3	1	3	3
Glaucous Gull	35	714	182	34	24	102	321
Survey Area (km^2)	6.35	68.58	22.86	22.86	6.35	25.40	24.77

Appendix 3. Coastal Survey No. 2: August 1, 1981, observed numbers

Land mark	Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	822	250	10	-	-	519	1268	237
Old Squaw	3417	253	77	1	2	295	1704	96
Eiders	79	-	-	-	-	-	-	-
Scoter	2250	81	194	-	-	265	201	27
Merganser	26	86	2	-	-	94	-	40
Loons	4	3	20	1	3	26	7	2
Glaucous Gull	139	153	536	39	577	882	206	234
Survey Area (km^2)	36.83	23.11	28.45	38.74	48.90	37.34	30.48	19.30

Appendix 3. Continued.

Land mark	McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Point	Ikpisugyuk Bay	Harrowby Bay	Cape Bathurst
Scaup	3	381	950	286	432	777	968
Old Squaw	385	767	2006	304	87	1152	1784
Eiders	60	74	2	-	271	33	768
Scoter	630	792	993	97	16	2938	417
Merganser	-	123	154	160	82	12	1
Loons	1	36	12	1	3	7	11
Glaucous Gull	76	327	99	235	5	103	71
Survey Area (km^2)	6.35	68.58	22.86	22.86	6.35	25.40	24.77

Appendix 4. Coastal Survey No. 3: August 11, 1981, observed numbers.

Land mark	Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	-	-	-	-	2	1241	1599	60
Old Squaw	-	-	-	-	-	80	185	32
Eiders	-	-	-	-	-	-	-	-
Scoter	-	-	-	-	-	408	43	-
Merganser	-	-	-	-	-	966	6	223
Loons	-	-	-	-	8	33	17	8
Glaucous Gull	-	-	-	13	219	239	187	39
Survey Area (km^2)	-	-	-	31.12	34.93	37.34	30.48	19.30

Appendix 4. Continued.

Land mark	McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Point	Ikpisugyuk Bay	Harrowby Bay	Cape Bathurst
Scaup	84	668	296	852	233	439	100
Old Squaw	243	939	33	131	71	246	743
Eiders	-	12	-	-	-	-	2
Scoter	294	791	137	55	1	400	39
Merganser	-	92	14	37	33	31	57
Loons	2	37	4	29	1	5	18
Glaucous Gull	20	170	26	73	13	9	64
Survey Area (km^2)	6.35	68.58	22.86	22.86	6.35	25.40	24.77

Appendix 5. Fall Migration and Staging Survey: September 11, 1981, observed numbers.

Land mark	Nunaluk Spit	To Kay Point	To Shingle Point	To Shallow Bay	To Kugmallit Bay	To Tuktoyaktuk	To Hutchison Bay	To Atkinson Point
Scaup	-	-	-	-	-	-	611	327
Old Squaw	46	20	19	-	-	2	748	2774
Eiders	-	8	-	-	-	-	1	-
Scoter	10	3	-	-	-	-	286	164
Merganser	-	-	174	-	-	185	313	12
Loons	-	-	1	-	3	2	-	1
Glaucous Gull	302	260	222	2	214	131	241	47
Survey Area (km^2)	14.61	11.56	14.22	14.92	24.45	18.67	30.48	19.30

Appendix 5. Continued.

Land mark	McKinley Bay	To Cape Dalhousie	Wood Bay	To Maitland Point	Ikpisugyuk Bay	Harrowby Bay	Cape Bathurst
Scaup	6	52	579	378	110	1130	-
Old Squaw	21	2074	15	1762	387	423	63
Eiders	-	93	-	-	-	16	43
Scoter	102	76	-	3	8	44	1
Merganser	-	1	-	27	20	65	-
Loons	-	11	-	2	3	8	-
Glaucous Gull	68	193	45	37	10	50	157
Survey Area (km^2)	6.35	68.58	22.86	22.86	6.35	25.40	24.77